

2 Introduction

2.1 Background

To support mine planning for the Pebble Project, a detailed environmental geochemical characterization program is ongoing focused on materials that may constitute wastes generated by the mine.

The aims of the program are to:

- Geochemically characterize materials that could be produced during mining and milling and determine their likely geochemical behavior following disturbance by mining activities;
- Provide data that can be used to make decisions about waste management approaches; and
- Obtain information that can be used to estimate the chemistry of water in contact with these materials.

The program commenced in 2004 and since then a large body of data have been obtained. Although a large proportion of the planned testwork is complete, a number of longer term kinetic weathering tests are ongoing (humidity cells, subaqueous columns and field barrel tests).

Kinetic tests provide specific data to answer the questions of whether rock/tailings could generate acid rock drainage (ARD) (depending on how the material is managed), when ARD would be generated, and how rates of leaching are related to factors such as mineralogy, sulfur, metal content, leachate chemistry and disposal conditions. Each test provides information on these aspects and is usually continued until the test results no longer add significant new information to the understanding of the metal leaching and ARD (ML/ARD) aspects of the project.

Thorough review of the test data has occurred at various times and decisions made to finish or continue tests as a result of trends in leachate chemistry. The duration of tests at completion is determined by the timing of these reviews and the date the tests started. There is no correlation of the actual termination date with short term effects observed in leachate chemistry trends.

The kinetic testwork program includes both laboratory and field tests. This memorandum describes:

- the status of the laboratory-based component of the kinetic testwork program at the current time and makes recommendations for completion of a number of the tests; and
- proposes reduction in monitoring frequency.

The program includes study of waste rock and tailings and these are discussed in turn in the later sections.

2.2 Geological Terminology and Overall Geochemical Characteristics

The geological setting will not be described in detail here. The main geological features of the Pebble Deposit are (1) porphyry mineralized Cretaceous (Pre-Tertiary) age sedimentary and intrusive rocks containing the copper, gold and molybdenum mineralization; and (2) overlying Tertiary age sedimentary, volcano-sedimentary and sedimentary rocks deposited on the eroded Cretaceous rocks. The Tertiary rocks do not contain porphyry mineralization though are locally mineralized with iron sulfides.

Static geochemical characterization to date has determined that the Pre-Tertiary rocks have potential to generate ARD if not managed appropriately. In contrast, the Tertiary rocks have low potential for ARD due to generally low levels of iron sulfide minerals and relatively abundant acid neutralizing carbonate minerals.

2.3 Supporting Documents

The memorandum "Status of Kinetic Tests - Pebble Project" (November 22, 2006) (SRK 2006) previously described the status of the testwork and was provided to ADNRC. Summaries of the kinetic test program have been provided as part of annual meetings with State of Alaska and Federal agency staff.

3 Waste Rock Samples

3.1 Introduction

The laboratory program includes both humidity cell tests and subaqueous columns to examine reaction kinetics under unsaturated conditions and under flooded conditions, respectively. The overall number of tests in program classified according to age (Tertiary and Pre-Tertiary), rock type (plutonic, sedimentary, volcanic) and zone (West and East) are summarized in Figures 1 and 2.



3.2 Humidity Cells

Tables 1 to 3 summarize characteristics of the samples used in each test, and give information about the status of each test. Also given in the tables are recommendations to complete those tests that are showing stable trends and are not expected to yield new information on a reasonable laboratory timescale. The following sections describe briefly selected outcomes of the testwork, and give justifications for recommended changes to the program.

3.2.1 Pebble West Zone: Pre-Tertiary

As summarized in Section 1.2, Pre-Tertiary rock generally has the potential to generate ARD. However, the rock contains a range of neutralization potentials (NP) resulting in the delay to appearance of ARD spanning decades. Samples for testing were deliberately selected to evaluate both the development of acidic conditions and leaching effects under non-acidic conditions.

Two categories of rock are being characterized:

- Volcano-sedimentary - Eight samples of wacke (W) and mudstone/siltstone (Y) were tested. Seven tests were completed in 2005 (as described by SRK 2006) because they had either generated acid or were not expected to generate acid for many years. One test (Sample 3124-0188-0209) is ongoing (over 4 years of testing). Graphs showing results are provided in Attachment A.
- Plutonic - Nine samples of plutonic igneous rocks were tested. Eight tests were completed in 2005 (SRK 2006) for the same reason indicated above. One test (Sample 3069-0927-0947) is ongoing (over 4 years of testing). Graphs showing results are provided in Attachment B.

The two ongoing samples are showing stable leachate chemistry under acidic conditions.

The objectives of these tests have been met. They have demonstrated that samples with relatively low NP (<10 kg CaCO₃/t) have the potential to generate acid, either immediately, or following relatively short test durations. Samples with higher NP produced pH neutral leachate. Rates of oxidation have been shown to correlate with sulfur content of the rocks. Stable metal release rates have now been collected for a range of pH conditions, sample types and bulk chemistries.

It is proposed that the two ongoing tests are continued to provide long-term data under acidic conditions for one sample from each rock type category.

3.2.2 Pebble West Zone: Tertiary

Nine Pebble West Zone Tertiary rock samples have been or continue to be tested, with two samples being tested as triplicates to assess reproducibility of results (total of 13 tests). Of these thirteen tests, six have already been completed (as described in SRK 2006) and seven are ongoing now for over 3 years. Graphs showing results are provided in Attachment C.

The majority of Tertiary rock types are not expected to generate acid. A very small component contains elevated pyrite concentrations and may generate acid. Two samples in this category are being tested. The program is designed primarily to assess element leaching under non-acidic conditions and relationships between sulfide content and element leaching.

Most samples now show stable leachate chemistry enabling leaching rates to be compared to bulk rock characteristics. Therefore, the objectives of the tests have been met. All samples have generated

leachates that were pH neutral or slightly alkaline. Release rates for the majority of parameters are either stable or gradually decreasing with time. The exceptions are:

- Sample 4157 439-471 (sedimentary rock type, TF). This sample has AP of 117 kg CaCO₃/t compared to typical values an order of magnitude lower and consequently elevated sulfate release compared to other samples. The leachate pH remains neutral because the sample has significant NP. The sulfate release rate appears to be increasing very gradually over time. The fluorine release rate for this sample is also rising.
- Sample 4292 415-430 (volcanic rock type, TA/TD) – The fluorine release rate for this sample is rising.

Both these samples have NP/AP less than 1 indicating a possibility that acid conditions could develop over the very long term (6 to 11 years based on the current rates of depletion of NP). It is proposed that these two tests remain in place to allow fluorine and sulphate release rates to stabilize. They also provide a possible opportunity to observe acidic conditions for Tertiary waste rock, should such conditions arise.

All other samples studies have lower ARD potential based NP/APs mostly well above 1 and also have lower APs. Acidic conditions are not expected to develop. It is proposed that all ongoing tests in this category be completed after being tested for 3 to 4 years. These tests are:

- Sample 115-0142-0163 (sedimentary rock type, TC) - This sample was tested in triplicate. Reproducibility of the triplicate was very good. Given that reproducibility has been demonstrated and the leachate chemistry is stable the objectives of the tests have been met.
- Sample 4292 685-695 (sedimentary rock type, TC) – The leachate chemistry is stable.
- 3102-0958-0978 (volcanic rock type, TB) - The leachate chemistry is stable.

3.2.3 Pebble East Zone: Pre-Tertiary

As was the case with the Pebble West zone samples, the same two categories of rock are being characterized:

- Volcano-sedimentary – Five samples are being characterized, all from the most abundant lithology, meta-mudstone (Y). Graphs showing results are provided in Attachment D.
- Plutonic - Seven samples are being tested, six from the volumetrically abundant granodiorite lithology, and one diorite sample. Graphs showing results are provided in Attachment E.

The samples are showing similar trends to those shown by the Pebble West Zone samples. For example, samples with relatively low NP (less than 10 kg CaCO₃/t) have been demonstrated to generate acid, either immediately, or following relatively short test durations. Samples with higher NP are associated with neutral pH leachate.

After detailed examination of the trends that have developed, it is proposed that the following five tests be completed after over a year of testing:

Volcano-sedimentary samples

- Sample 406717 – Acidic conditions have developed in this test as would be expected on the basis of the NP/AP. The leachate chemistry for this sample is stable and so the objective of the test has been met.
- Sample 107326 – This sample is showing trends very similar to Sample 107172 (neutral pH leachate, rising Mo release rates). It is proposed that this test be completed, while the test involving the comparable Sample 107172 is continued.

Plutonic samples

- Sample 224182 – Mildly acidic conditions have developed in this test as would be expected on the basis of the NP/AP ratio. The leachate chemistry for this sample is stable and so the objective of the test has been met.
- Sample 226293 – The sample has NP/AP>1 and is giving pH neutral leachate as expected. Most metal release rates are stable, although Mo release is decreasing gradually, and Sn release is increasing. Sample 224956 is showing very similar trends. It is proposed that the test involving Sample 226293 be terminated, whilst the test involving Sample 224956 continue.
- Sample 105456 - Acidic conditions have developed in this test as would be expected on the basis of the limited NP, and NP/AP<1. The leachate chemistry for this sample is stable and so the objective of the test has been met.

Seven tests will continue because leachate chemistry under non-acidic and acidic conditions has not stabilized.

3.2.4 Pebble East Zone: Tertiary

Thirteen Pebble East Zone samples are being tested. Graphs showing results are provided in Attachment F. As was the case with the Pebble West zone samples, the majority of these samples were not expected to generate acid. Most tests now show stable leachate chemistry; therefore, the objectives of the tests have been met. All samples have generated leachates that were pH neutral or slightly alkaline as expected from their bulk characteristics. Release rates for the majority of parameters are either stable or gradually decreasing with time.

It is proposed that most of these tests be completed following over a year of testing as the objectives of the tests have been met. Exceptions are the following tests, which should continue:

- Samples 220366 and Sample 221502 - These tests were started in November 2008 to provide additional coverage of the range of NP/AP in the Tertiary rocks types. The leachate chemistry does not yet appear to have stabilized and pHs are below 6.
- Sample 104772 – The leachate pH is near 5 and slightly below the pH of deionized water in the test. The pH is gradually decreasing with time and accompanied by coincident increase in metal release rates. This sample shows the highest release rates for some metals, e.g. Cd, Cu and Zn.

3.2.5 Barrel Tests Samples

Ten samples (four Pre-Tertiary and six Tertiary) are being characterized in field (barrel) tests and equivalent humidity cell tests. They provide an opportunity to obtain data in the laboratory program that

Although most of the release trends for these tests appear largely stable, it is proposed that these tests continue, principally due to their value in terms of comparisons with the data derived from the field tests.

One sample of an ore composite is being studied. Graphs showing results are provided in Attachment H. The test has been running for just over a year and is yielding pH neutral leachate. Based on the NP of 6.9 kg CaCO₃/t, it is expected that acid conditions would develop over time. Some metal release rates are showing gradual increases over time, e.g. Cd, Cu and Zn. It is proposed this test continue to determine if acid conditions will develop, and allow the metal release rates to stabilize.

These tests are intended to simulate weathering of rock in subaqueous rather than aerated conditions as would occur when waste rock or mine surfaces are flooded. Table 4 summarizes characteristics of the samples used in each test, and gives information about the status of each test. Also given in the table are recommendations to terminate those tests that are showing stable trends and are not expected to yield new information on a reasonable laboratory timescale. The following sections describe selected outcomes of the testwork, and give justifications for recommendations that have been made.

It should be noted that a further 12 samples are currently being stored under aerated, humid conditions ('stored bag' tests). This storage regime is intended to encourage sulphide oxidation and weathering, to represent exposure of waste rock to aerial conditions prior to submergence for long term storage. The long term intention is for a subset of these 'weathered' samples to be studied in subaqueous columns. These columns will be included in proposals for the 2010 program of work.

Six Pre-Tertiary samples are being characterized covering a range of rock types (volcano-sedimentary and plutonic). Of these six tests, two were completed in 2006 (SRK 2006). Graphs showing results are provided in Attachment I.

- Sample 3069-0927-0947 – The leachate chemistry shows some variability in pH and sulphate release and the release rate for several elements are showing increases over time, e.g. As, Sb and to a lesser extent Cu and Zn. It is proposed that this test be continued.
- Sample 3102-0568-0588 – The leachate chemistry appears stable. A very gradual increase in sulphate release rate is observed after 600 days which is correlated with an increase in the redox potential. It is proposed that this test be completed.
- Sample 3124-0188-0209 – This sample shows trends similar to Sample 3069-0927-0947, although the metal release rates appear more stable. It is recommended that this test be completed.
- Sample 3124-0872-0887 – This sample shows stable leachate chemistry. It is proposed this test be completed.

3.3.2 Pebble East Zone

Two Tertiary samples are being studied, one each of sedimentary and volcanic rock types. Graphs showing results are provided in Attachment J. These tests have been running less than a year, and the leachate chemistry has not yet stabilized. It is proposed that both tests continue.

4 Tailings Samples

4.1 Metallurgical Process Background and Geochemical Characteristics

Several phases of metallurgical testwork have been performed for Pebble Project since 2005 resulting in generation of tailings products for geochemical testing.

The proposed metallurgical process would use flotation to separate commodity sulfide minerals from the ore. Separation would occur in two stages. The first stage would float both waste and commodity sulfide minerals to a bulk sulfide concentrate resulting in a low sulfide bulk or rougher tailings product. The second stage floats commodity sulfide minerals (chalcopyrite and molybdenite) from the bulk concentrate leaving pyrite tailings. To date, testwork has focused on characterizing the bulk tailings products while gold recovery from the pyrite tailings has been evaluated.

Kinetic testing has used two sets of tailings products from metallurgical testwork in 2005 and 2008. The 2005 program used West Zone ore and was performed at the bench scale. In 2008, the metallurgical program evaluated recovery of metals from West and East Zone ore composites in a pilot plant. Processing of East Zone ores also considered rock type as a variable. In addition, the ability to generate tailings sand using cyclones was evaluated. All types of samples are being characterized in geochemical testwork

Static geochemical testwork has consistently shown that the bulk tailings product should have low sulfur content (0.1%) and sufficient NP to result in bulk tailings that have low potential for ARD. A significant difference between the zones is that NP in the East Zone is lower than West Zone

The tailings kinetic testwork program comprises mainly humidity cell tests. In addition, two column tests were undertaken using the 2005 tailings samples. The number of tests included in the program is summarized in Figure 3.

Table 5 summarizes characteristics of the samples used in each test, and gives information about the status of each test. Also given in the table are recommendations to terminate those tests that are showing stable trends and are not expected to yield new information on a reasonable laboratory timescale. The following sections describe briefly selected outcomes of the testwork, and give justifications for recommendations that have been made.

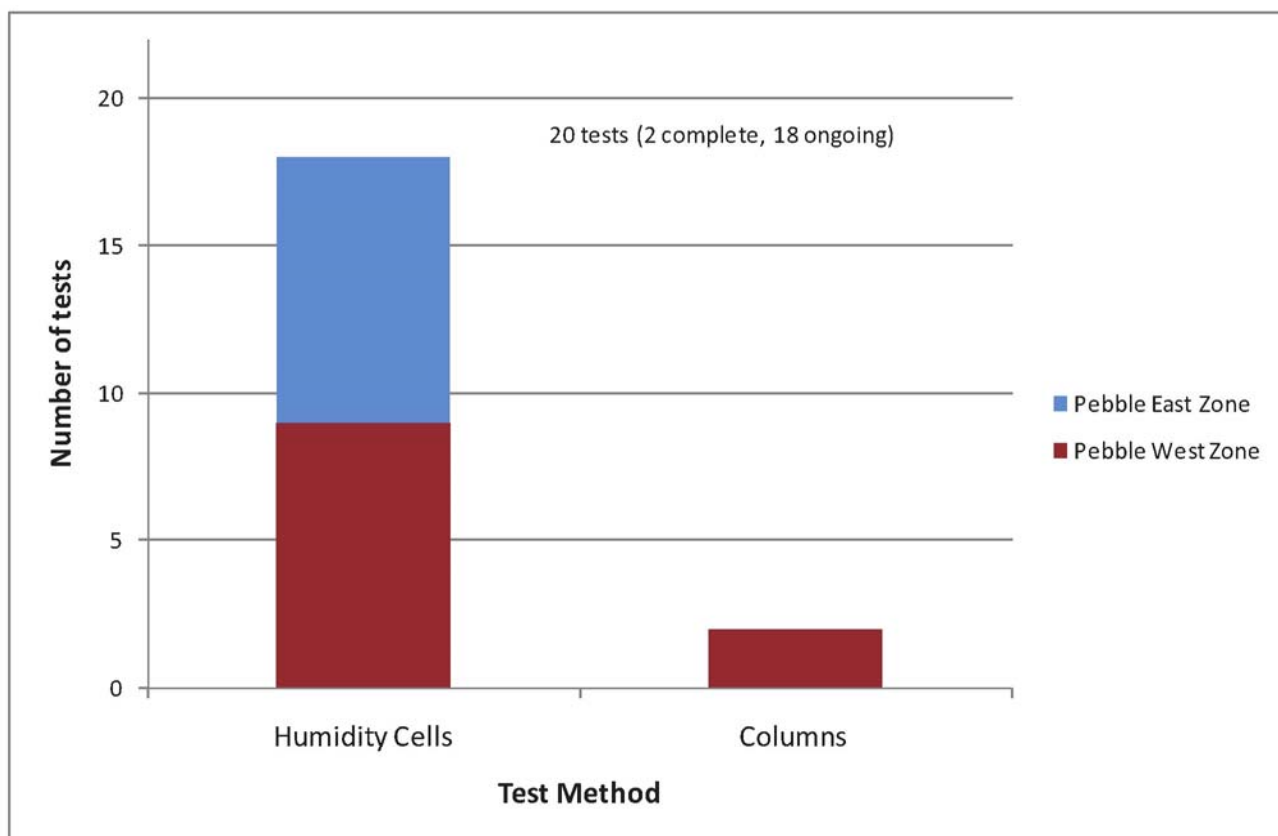


Figure 3: Summary of Tests undertaken involving Pebble Tailings

4.2 Humidity Cells

4.2.1 2005 West Zone Samples

Two samples of two types of tailings (total four samples) were provided for geochemical characterization, both tailings types are components of the bulk tailings stream. Two of the tests were completed in 2005 and two tests have been continuing for over 4 years. Graphs showing results are provided in Attachment K.

The two continuing tests are showing stable leachate chemistry. Leachate is pH neutral and release rates either remain constant or are decreasing very gradually. It is proposed that the two remaining tests be completed because the objective of the testwork has been met.

4.2.2 2008 Samples

Fourteen samples are currently being characterized (Table 5). These can be grouped as follows:

- East Zone individual rock type composites for metasediments (Y) and intrusive (G) tested as bulk tailings, and separated sands and slimes products produced by cycloning.
- East Zone combined rock type composite (80% G and 20% Y) similarly tested as bulk, sands and slimes.

- West Zone single rock type composite (termed H for hypogene) tested as two components of the bulk tailings (cleaner and scavenger tailings) and pyrite rougher tailings from initial cleaning of the bulk sulfide concentrate. The pyrite rougher tailings are not the final pyrite tailings.

Graphs showing results are provided in Attachment L. Overall interpretation of the test data (including the 2005 tests) shows that predictable relationships exist between sulfur content and particle size after leachate chemistry stabilizes, which generally occurs less than a year into testing. For a given tailings particle size product (bulk, sands or slimes), oxidation rates are correlated with sulfur content. For a given tailings composite, oxidation rates are negatively correlated with particle size. That is, under laboratory conditions, as particle size decreases oxidation rates increases. This latter finding is consistent with oxidation as a surface area phenomenon.

Eight of the tests (East Zone Rock Type Composite and West Zone Composite) have been running for less than a year. The leachate chemistry has not yet stabilized and it is proposed that these tests be continued.

The six other tests (PP08 series samples) have been running for a year and generally show stable leachate chemistry correlated with bulk characteristics. Leachate is pH neutral and release rates either remain constant or are decreasing very gradually. It is proposed that four of the tests be completed.

It is proposed that the two tests involving cyclone sands (PP08-3850 and PP08-3849) be continued due to their potential importance as a component of tailings beaches and a construction material should the project proceed with use of cyclone sands for dam building.

The proposed ongoing test program consists of:

- East and West Zone rock type composite bulk, sands and slimes tailings samples.
- Two additional sands samples for individual rock types from the East Zone.

4.2.3 2005 Tailings Samples Columns

Two of the scavenger tails samples were studied. Both tests are ongoing. Graphs showing results are provided in Attachment M.

The tests have been running for more than 4 years and the leachate chemistry is generally stable. However, in the case of Sample S2-Scavenger Tails, the Mo release started to increase at around 900 days, and continues to rise. It is recommended that this test be continued to evaluate the trend in molybdenum release rates. It is proposed that the S1-Scavenger Tails column be terminated.

5 Proposed Changes to Monitoring Frequency

As testwork continues, less frequent monitoring results are needed to discern trends in leachate chemistry. Table 6 provides proposed changes to the leachate analysis for all tests proposed for continuation.

Table 1: Characteristics and Status of Pebble West Zone Waste Rock Samples in Humidity Cell Tests

Sample ID	Rock Type	Date Started	Last data	Duration	NP	AP	NP/AP	Recent Leachate pH	Calculated Time to onset of acid conditions ⁽¹⁾	Status and Recommendation	Reasons for Previous Decision or Proposed Change
			Years		kg CaCO ₃ /t	kg CaCO ₃ /t			Years		
Pre-Tertiary Plutonic Rock											
025-0617-0637	D	08-Feb-05	30-Aug-05	0.6	9.8	105.3	0.09	pH < 5	-	Completed	Stable leachate chemistry under acidic conditions
046-0113-0133	N	08-Feb-05	30-Aug-05	0.6	6.1	53.4	0.11	5<pH<6	-	Completed	Stable leachate chemistry under acidic conditions
046-0580-0600	G	08-Feb-05	30-Aug-05	0.6	8.0	45.0	0.18	pH neutral	8	Completed	Stable leachate chemistry. Not expected to generate acid in short term
112-0460-0480	X	08-Feb-05	30-Aug-05	0.6	5.6	91.6	0.06	pH neutral	6	Completed	Stable leachate chemistry. Not expected to generate acid in short term
117-0190-0210	N	09-Feb-05	31-Aug-05	0.6	5.6	58.1	0.10	pH neutral	5	Completed	Stable leachate chemistry. Not expected to generate acid in short term
118-0468-0488	M	09-Feb-05	31-Aug-05	0.6	37.5	36.6	1.03	pH neutral	24	Completed	Stable leachate chemistry. Not expected to generate acid in short term
3069-0927-0947	G	09-Feb-05	Ongoing	4.2	3.2	76.3	0.04	pH < 5	-	Continue	Will provide long-term data for this rock category
3123-0438-0458	D	10-Feb-05	01-Sep-05	0.6	41.8	152.5	0.27	pH neutral	39	Completed	Stable leachate chemistry. Not expected to generate acid in short term
3124-0872-0887	X	10-Feb-05	29-Jun-06	1.4	45.5	44.4	1.03	pH neutral	25	Completed	Stable leachate chemistry. Not expected to generate acid in short term
Pre-Tertiary Volcano-Sedimentary Rock											
019-0072-0090	WY	08-Feb-05	30-Aug-05	0.6	0.4	12.5	0.04	5<pH<6	-	Completed	Stable leachate chemistry under acidic conditions
033-0137-0155	Y	08-Feb-05	30-Aug-05	0.6	26.5	68.4	0.39	pH neutral	24	Completed	Stable leachate chemistry. Not expected to generate acid in short term
047-0350-0365	WY	08-Feb-05	27-Jun-06	1.4	6.1	104.7	0.06	pH neutral	5	Completed	Stable leachate chemistry. Not expected to generate acid in short term
118-0520-0535	Y	09-Feb-05	31-Aug-05	0.6	30.9	92.5	0.33	pH neutral	10	Completed	Stable leachate chemistry. Not expected to generate acid in short term
118-1220-1238	WY	09-Feb-05	31-Aug-05	0.6	32.6	77.5	0.42	pH neutral	15	Completed	Stable leachate chemistry. Not expected to generate acid in short term
3102-0568-0588	Y	09-Feb-05	31-Aug-05	0.6	18.5	97.8	0.19	pH neutral	11	Completed	Stable leachate chemistry. Not expected to generate acid in short term
3115-0988-1008	Y	10-Feb-05	29-Jun-06	1.4	10.0	46.3	0.22	pH neutral	10	Completed	Stable leachate chemistry. Not expected to generate acid in short term
3124-0188-0209	Y	10-Feb-05	Ongoing	4.2	0.1	77.2	0.00	pH < 5	-	Continue	Will provide long-term data for this rock category
Tertiary											
115-0054-0066	TC sillstone	09-Feb-05	31-Aug-05	0.6	29.0	6.3	4.64	pH neutral		Completed	Decreasing trend shown. Sample 115-0142-0163 was continued as an example of same rock type
115-0054-0066	TC sillstone	22-Feb-05	30-Aug-05	0.5	29.0	6.3	4.64	pH neutral		Completed	Reproducibility shown
115-0054-0066	TC sillstone	22-Feb-05	30-Aug-05	0.5	29.0	6.3	4.64	pH neutral		Completed	Reproducibility shown
115-0142-0163	TC arkose (higher S)	09-Feb-05	Ongoing	4.2	41.4	9.4	4.41	pH neutral		Complete	Stable leachate chemistry
3129-0253-0272	TC (and/vol cng)	10-Feb-05	29-Jun-06	1.4	83.8	3.1	26.80	pH neutral		Completed	Stable leachate chemistry
3129-0417-0435	TC (and/vol cng)	10-Feb-05	01-Sep-05	0.6	98.5	0.6	157.60	pH neutral	6	Completed	Release trends paralleled 3129-0253-0272 (same rock) which was continued a little longer.
4157-439-471	TF	01-Nov-05	Ongoing	3.5	21.9	116.9	0.19	pH neutral		Continue	Leachate chemistry not yet stable
4292-685-695	TC	01-Nov-05	Ongoing	3.5	83.7	75.3	1.11	pH neutral		Complete	Stable leachate chemistry
117-1055-1071	TBd (low S)	09-Feb-05	31-Aug-05	0.6	108.5	7.8	13.89	pH neutral		Completed	Similar results to sample 3102-0958-0978 on same rock type.
3102-0958-0978	TBd	10-Feb-05	Ongoing	4.2	103.3	21.3	4.86	pH neutral		Complete	Stable leachate chemistry
3102-0958-0978	TBd	10-Feb-05	Ongoing	4.2	103.3	21.3	4.86	pH neutral		Complete	Reproducibility shown
3102-0958-0978	TBd	10-Feb-05	Ongoing	4.2	103.3	21.3	4.86	pH neutral		Complete	Reproducibility shown
4292-415-430	TA/TD	01-Nov-05	Ongoing	3.5	17.2	27.2	0.63	pH neutral	11	Continue	Leachate chemistry not yet stable

[1] Onset of acid conditions is only expected in the case of those samples with NP/AP less than unity, i.e. there is insufficient NP to neutralize all the potential acid that might be generated in the sample. The timescale is calculated based on the observed rate at which NP is depleting in the sample concerned.

Table 2: Characteristics and Status of Pebble East Zone Waste Rock Samples in Humidity Cell Tests

Sample ID	Rock Type	Started	Last data	Duration	NP	AP	NP/AP	Recent Leachate pH	Calculated Time to onset of acid conditions ^[1]	Status and Recommendation	Reasons for Previous Decision or Proposed Change
				Years	kg CaCO ₃ /t	kg CaCO ₃ /t			Years		
Pre-Tertiary Plutonic Rock											
224956	D	17-Jan-08	Ongoing	1.3	25.4	65.6	0.4	pH neutral	26	Continue	Some release rates not yet stable; Mo decreasing
224182	G	16-Jan-08	Ongoing	1.3	2.5	24.1	0.1	5<pH<6	-	Complete	Stable leachate chemistry under mildly acidic conditions
226293	Gp	17-Jan-08	Ongoing	1.3	31.3	16.6	1.9	pH neutral	30	Complete	Release trends parallel Sample 224956. Test for Sample 224956 will continue.
406692	Gs	15-Jan-08	Ongoing	1.3	6.4	398	0	pH<5	-	Continue	Leachate chemistry not yet stable
225026	Gs	15-Jan-08	Ongoing	1.3	7.5	30	0.3	5<pH<6	-	Continue	Leachate chemistry not yet stable
105391	Gs	16-Jan-08	Ongoing	1.3	1	452	0	pH<5	-	Continue	Leachate chemistry not yet stable
105456	Gs	16-Jan-08	Ongoing	1.3	2.3	233	0	pH<5	-	Complete	Stable leachate chemistry under acidic conditions
Pre-Tertiary Volcano-Sedimentary Rock											
220841 + 220842	Y	15-Jan-08	Ongoing	1.3	4.9	69.7	0.1	pH<5	-	Continue	Leachate chemistry not yet stable
406717	Y	15-Jan-08	Ongoing	1.3	7.4	305	0	pH<5	-	Complete	Stable leachate chemistry under acidic conditions
107326	Y	16-Jan-08	Ongoing	1.3	13.7	17.2	0.8	pH neutral	18	Complete	Release trends parallel Sample 107172. Test for Sample 107172 will continue.
107172	Y	17-Jan-08	Ongoing	1.3	5.8	37.5	0.2	pH neutral	7	Continue	Some release rates not yet stable; Mo decreasing
220076	Y2L	16-Jan-08	Ongoing	1.3	14.8	283	0.1	5<pH<6	-	Continue	Leachate chemistry not yet stable
Tertiary Rock											
104472	TC	15-Jan-08	Ongoing	1.3	10.7	27.5	0.4	pH<5	-	Continue	Leachate pH is still decreasing and this sample has highest release rates for some metals
406558	TC	17-Jan-08	Ongoing	1.3	62.5	47.8	1.3	pH neutral	62	Complete	Stable leachate chemistry
220394	TC	17-Jan-08	Ongoing	1.3	92.7	1.3	74.2	pH neutral		Complete	Stable leachate chemistry
219084	TF	16-Jan-08	Ongoing	1.3	106.4	1.3	85.1	pH neutral		Complete	Stable leachate chemistry
406502	TF	17-Jan-08	Ongoing	1.3	36.6	3.8	9.8	pH neutral		Complete	Stable leachate chemistry
219135	TW	15-Jan-08	Ongoing	1.3	70.4	7.5	9.4	pH neutral		Complete	Stable leachate chemistry
220364	TY	15-Jan-08	Ongoing	1.3	60.8	4.1	15	pH neutral		Complete	Stable leachate chemistry
219189	TY	17-Jan-08	Ongoing	1.3	51.5	4.7	11	pH neutral		Complete	Stable leachate chemistry
220366	TY	20-Nov-08	Ongoing	0.4	8.1	56.3	0.1	pH<5	-	Continue	Leachate chemistry not yet stable
222788	TA d	16-Jan-08	Ongoing	1.3	34.6	79.7	0.4	pH neutral	33	Complete	Stable leachate chemistry
226785	TB	16-Jan-08	Ongoing	1.3	83.3	53.8	1.5	pH neutral	66	Complete	Stable leachate chemistry
104775	TD	15-Jan-08	Ongoing	1.3	14	0.9	14.9	pH neutral		Complete	Stable leachate chemistry
221502	TD	20-Nov-08	Ongoing	0.4	28.2	47.8	0.6	5<pH<6	-	Continue	Leachate chemistry not yet stable
Ore Composite											
11486-001 AT COMP – 10m	Ore composite	9-Apr-08	Ongoing	1.0			0.09	pH neutral	13	Continue	Only sample of this type being studied. Leachate chemistry not yet stable

[1] Onset of acid conditions is only expected in the case of those samples with NP/AP less than unity, i.e. there is insufficient NP to neutralize all the potential acid that might be generated in the sample. The timescale is calculated based on the observed rate at which NP is depleting in the sample concerned.

Table 3: Characteristics and Status of Field Barrel Test Waste Rock Samples in Humidity Cell Tests

Sample ID	Rock Type	Started	Last data	Duration	NP	AP	NP/AP	Recent Leachate pH	Calculated Time to onset of acid conditions ^[1] years	Status and Recommendation	Reasons for Previous Decision or Proposed Change
ARLB003	G/D/N	18-Jan-08	Ongoing	1.3	28.90	183.44	0.16	pH neutral	12.40	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB006	G/D/N	18-Jan-08	Ongoing	1.3	21.30	100.00	0.21	pH neutral	11.72	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB001	Y	18-Jan-08	Ongoing	1.3	6.50	198.44	0.03	pH<5	-	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB002	Y	18-Jan-08	Ongoing	1.3	6.20	189.06	0.03	pH<5	-	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB007	TC/TF	18-Jan-08	Ongoing	1.3	90.20	22.19	4.07	pH neutral	58.01	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB008	TC/TF	18-Jan-08	Ongoing	1.3	70.10	6.56	10.68	pH neutral	72.24	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB004	TW	18-Jan-08	Ongoing	1.3	67.20	5.31	12.65	pH neutral	73.65	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB005	TY	18-Jan-08	Ongoing	1.3	63.40	15.00	4.23	pH neutral	27.57	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB009	TD	18-Jan-08	Ongoing	1.3	44.80	5.00	8.96	pH neutral	38.22	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data
ARLB010	TA+TB	18-Jan-08	Ongoing	1.3	48.10	1.56	30.78	pH neutral	58.19	Continue	To obtain long-term data for comparison with equivalent field (barrel) tests data

[1] Onset of acid conditions is only expected in the case of those samples with NP/AP less than unity, i.e. there is insufficient NP to neutralize all the potential acid that might be generated in the sample. The timescale is calculated based on the observed rate at which NP is depleting in the sample concerned.

Table 4: Characteristics and Status of Waste Rock Samples in Subaqueous Columns

Sample ID	Rock Type	Zone	Started	Last data	Duration	NP	AP	NP/AP	Recent Leachate pH	Calculated Time to onset of acid conditions ^[1] Years	Status and Recommendation	Reasons for Previous Decision or Proposed Change
3069-0927-0947	G	PWZ	28-Sep-05	Ongoing	3.6	3.2	76.3	0.04	pH<5	-	Continue	Leachate chemistry not stable. Increasing As release rate over time
3102-0568-0588	Y	PWZ	28-Sep-05	Ongoing	3.6	18.5	97.8	0.19	pH neutral	15.7	Complete	Stable leachate chemistry
3115-0988-1008	Y	PWZ	28-Sep-05	28-Jun-06	0.7	10.0	46.3	0.22	pH neutral	24.3	Completed	Stable leachate chemistry
3123-0438-0458	D	PWZ	28-Sep-05	28-Jun-06	0.7	41.8	152.5	0.27	pH neutral	63.2	Completed	Stable leachate chemistry
3124-0188-0209	Y	PWZ	28-Sep-05	Ongoing	3.6	0.1	77.2	0.00	pH<5	-	Complete	Stable leachate chemistry
3124-0872-0887	X	PWZ	26-Oct-05	Ongoing	3.5	45.5	44.4	1.03	pH neutral	42.3	Complete	Stable leachate chemistry
Composite13	TC	PEZ	10-Aug-08	Ongoing	0.7	80.7	6.3	12.91	pH neutral	483.0	Continue	Leachate chemistry not yet stable
Composite19	TA	PEZ	10-Aug-08	Ongoing	0.7	17.5	17.5	1.00	pH neutral	18.0	Continue	Leachate chemistry not yet stable

[1] Onset of acid conditions is only expected in the case of those samples with NP/AP less than unity, i.e. there is insufficient NP to neutralize all the potential acid that might be generated in the sample. The timescale is calculated based on the observed rate at which NP is depleting in the sample concerned.

Note: A further 12 PEZ samples are currently being stored under aerated, humid conditions ('stored bag' tests). The long term intention is for a subset of these 'weathered' samples to be studied in subaqueous columns.

Table 5: Characteristics and Status of Tailings Samples in Humidity Cell Tests and Columns

Sample ID	Tailings Type	Zone	Started	Last data	Duration Years	NP kg CaCO ₃ /t	AP kg CaCO ₃ /t	NP/AP	Recent Leachate pH	Calculated Time to onset of acid conditions ⁽¹⁾ Years	Status and Recommendation	Reasons for Previous Decision or Proposed Change
Humidity Cell Tests (2005 Tailings Samples)												
S2-Scavenger Tails		PWZ	11-Feb-05	07-Oct-05	0.7	24.4	5.3	4.6	pH neutral	12.7	Completed	Well defined stable or decreasing trends
S2-Bulk Cleaner Tails		PWZ	11-Feb-05	Ongoing	4.2	23.3	9.7	2.4	pH neutral	7.8	Complete	Well defined stable or decreasing trends
S1-Scavenger Tails		PWZ	11-Feb-05	07-Oct-05	0.7	19.9	4.7	4.2	pH neutral	14.7	Completed	Well defined stable or decreasing trends
S1-Bulk Cleaner Tails		PWZ	11-Feb-05	Ongoing	4.2	19.6	6.9	2.9	pH neutral	9.9	Complete	Well defined stable or decreasing trends
Humidity Cell Tests (2008 Tailings Samples)												
PP08-3365	Y - bulk tails	PEZ	23-Apr-08	Ongoing	1.0	4.6	6.6	0.7	pH neutral	0.0	Complete	Well defined stable or decreasing trends
PP08-3607	Y - bulk tails (cyclone slimes)	PEZ	23-Apr-08	Ongoing	1.0	5.7	4.7	1.2	pH neutral	0.1	Complete	Well defined stable or decreasing trends
PP08-3850	Y - bulk tails (cyclone sands)	PEZ	23-Apr-08	Ongoing	1.0	6.3	8.4	0.7	pH neutral	0.6	Continue	To obtain long term data for this tailings type
PP08-3614	G - bulk tails	PEZ	23-Apr-08	Ongoing	1.0	5.7	2.8	2.0	pH neutral	0.1	Complete	Well defined stable or decreasing trends
PP08-3610	G - bulk tails (cyclone slimes)	PEZ	23-Apr-08	Ongoing	1.0	6.3	1.6	4.0	pH neutral	0.4	Complete	Well defined stable or decreasing trends
PP08-3849	G - bulk tails (cyclone sands)	PEZ	23-Apr-08	Ongoing	1.0	6.2	3.1	2.0	pH neutral	0.5	Continue	To obtain long term data for this tailings type
11486-003 bulk	G+Y bulk tails	PEZ	22-Oct-08	Ongoing	0.5	7.2	3.4	2.1	pH neutral	1.1	Continue	Leachate chemistry not yet stable
11486-003 OF	80G+20Y - Cyclone O/F (slimes)	PEZ	22-Oct-08	Ongoing	0.5	8.3	3.4	2.4	pH neutral	1.1	Continue	Leachate chemistry not yet stable
11486-003 UF	80G+20Y - Cyclone U/F (sands)	PEZ	22-Oct-08	Ongoing	0.5	7.0	6.3	1.1	pH neutral	1.2	Continue	Leachate chemistry not yet stable
11840-003 bulk cleaner	H-Bulk Cleaner Tails	PWZ	13-Aug-08	Ongoing	0.7	17.7	23.4	0.8	pH neutral	4.8	Continue	Leachate chemistry not yet stable
11840-003 pyrite	H - Pyrite Rougher Tails	PWZ	10-Sep-08	Ongoing	0.6	23.0	38.8	0.6	pH neutral	1.1	Continue	Leachate chemistry not yet stable
11840-003 bulk float	H - Bulk Tails (Bulk Scavenger Tails) as is	PWZ	10-Sep-08	Ongoing	0.6	22.3	4.4	5.1	pH neutral	10.5	Continue	Leachate chemistry not yet stable
11840-003 Phase II sands	H - Bulk Tails (Bulk Scavenger Tails) Cyclone Sands	PWZ	10-Sep-08	Ongoing	0.6	21.1	7.8	2.7	pH neutral	8.9	Continue	Leachate chemistry not yet stable
11840-003 Phase II OF	H - Bulk Tails (Bulk Scavenger Tails) Cyclone Slimes	PWZ	10-Sep-08	Ongoing	0.6	25.2	2.8	9.0	pH neutral	10.5	Continue	Leachate chemistry not yet stable
Columns (2005 Tailings Samples)												
S2-Scavenger Tails		PWZ	11-Feb-05	Ongoing	4.2	24.4	5.3	4.6	pH neutral	147.1	Continue	Mo release rate increasing.
S1-Scavenger Tails		PWZ	11-Feb-05	Ongoing	4.2	19.9	4.7	4.2	pH neutral	119.8	Complete	Well defined stable or decreasing trends

[1] Onset of acid conditions is only expected in the case of those samples with NP/AP less than unity, i.e. there is insufficient NP to neutralize all the potential acid that might be generated in the sample. The timescale is calculated based on the observed rate at which NP is depleting in the sample concerned.

Table 6: Proposed Changes to Monitoring Frequency for Ongoing Tests

Parameter Group	Early Stage Frequency	Ongoing Frequency
Leachate recovery	Weekly	Weekly
pH, ORP, Conductivity	Weekly	Every other week
Acidity, alkalinity, TDS, Hardness, Chloride, Fluoride, Sulphate	Every other week	Every fourth week
Element Scan	Every other week	Every fourth week

Attachment A
Graphs for Pre-Tertiary Volcano-Sedimentary Rock Humidity Cells
(Pebble West Zone)

SOA 080720

Attachment C
Graphs for Tertiary Rock Humidity Cells
(Pebble West Zone)

SOA 080722
360-287020

Attachment D
Graphs for Pre-Tertiary Volcano-Sedimentary Rock Humidity Cells
(Pebble East Zone)

SOA 080723
360-2870203

Attachment F
Graphs for Tertiary Rock Humidity Cells
(Pebble East Zone)

SOA 080725
360-2870-25

Attachment I
Graphs for Subaqueous Rock Columns
(Pre-Tertiary, Pebble West Zone)

SOA 080728
S01-360-287028

Attachment J
Graphs for Subaqueous Rock Columns
(Tertiary, Pebble East Zone)

SOA 080729

Attachment L
Graphs for Tailings Humidity Cells
(2008 Samples)

SOA 080731

